

WHAT IS CLAIMED IS:

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1. A solid-state image pickup apparatus
comprising:
 - a photoelectric conversion unit;
 - 5 transfer means for transferring signal charges
from said photoelectric conversion unit;
 - capacitance means for holding the transferred
signal charges; and
 - amplification means for outputting a signal
 - 10 corresponding to the signal charges held by said
capacitance means,
 - wherein said capacitance means having a
capacitance unit including a first capacitance value
and an additive capacitance unit for adding a
 - 15 capacitance to said capacitance unit to increase the
first capacitance value to obtain a second capacitance
value, and
 - wherein a signal read-out from said amplification
means has a first read-out mode in which a signal is
 - 20 read out while holding the signal charges in said
capacitance unit and said additive capacitance unit,
and a second read-out mode in which a signal is read
out while holding the signal charges in said
capacitance unit.
 - 25
2. An apparatus according to claim 1, further
comprising at least one different additive capacitance

unit for further adding a capacitance to said capacitance unit and said additive capacitance unit,

wherein read modes in which a signal is read out from said amplification means while holding the signal charges in said capacitance means in correspondence with each of capacitance values obtained by adding said different additive capacitance unit to each of said capacitance unit and said additive capacitance unit are prepared in number corresponding to the number of different additive capacitance units.

3. A solid-state image pickup apparatus comprising:

a photoelectric conversion unit;

capacitance means for holding signal charges transferred from said photoelectric conversion unit;

a transfer field effect transistor for transferring the signal charges from said photoelectric conversion unit and adding a capacitance formed by a channel to said capacitance means to increase a capacitance value; and

amplification means for outputting a signal corresponding to the signal charges held by said capacitance means or the signal charges held by said capacitance means and the capacitance of said transfer field effect transistor,

wherein a signal read-out from said amplification

means has a first read-out mode in which a signal is read out while holding the signal charges in said capacitance means and the capacitance of said transfer field effect transistor, and a second read-out mode in which a signal is read out while holding the signal charges in said capacitance means.

4. A solid-state image pickup apparatus comprising:

a photoelectric conversion unit;

first and second transfer means for transferring signal charges from said photoelectric conversion unit;

first capacitance means, inserted between said first transfer means and said second transfer means, for holding the transferred signal charges;

second capacitance means, arranged on an output side of said second transfer means, for holding the transferred signal charges; and

amplification means for outputting a signal corresponding to the signal charges held by said first and second capacitance means or the signal charges held by said second capacitance means,

wherein a signal read-out from said amplification means has a first read-out mode in which a signal is read out while holding the signal charges in said first and second capacitance means, and a second read-out mode in which a signal is read out while holding the

signal charges in said second capacitance means.

5 5. An apparatus according to claim 1, further comprising means for adding output signals in the respective read-out modes.

10 6. An apparatus according to claim 3, further comprising means for adding output signals in the respective read-out modes.

15 7. An apparatus according to claim 4, further comprising means for adding output signals in the respective read-out modes.

20 8. A solid-state image pickup apparatus comprising:

 a photoelectric conversion unit;

 transfer means for transferring signal charges from said photoelectric conversion unit;

25 capacitance means for holding the transferred signal charges; and

 amplification means for outputting a first signal without holding any signal charges in said capacitance means and outputting a second signal corresponding to the signal charges while keeping the signal charges held by said capacitance means,

 wherein said capacitance means including a

capacitance unit having a first capacitance value and
an additive capacitance unit for adding a capacitance
to said capacitance unit to increase the first
capacitance value to obtain a second capacitance value,
5 and

wherein a first signal read-out from said
amplification means has a first non-holding read-out
mode in which a signal is read out from said
capacitance unit without holding any signal charges,
10 and a second non-holding read-out mode in which a
signal is read out from said capacitance unit and said
additive capacitance unit without holding any signal
charges, and

a second signal read-out from said amplification
15 means has a first holding read-out mode in which a
signal is read out while keeping the signal charges
held by said capacitance unit, and a second holding
read-out mode in which a signal is read out while
keeping the signal charges held by said capacitance
20 unit and said additive capacitance unit.

9. An apparatus according to claim 8, wherein
further comprising at least one different additive
capacitance unit for further adding a capacitance to
25 said capacitance unit and said additive capacitance
unit,

wherein non-holding read-out modes in which a

signal is read out from said amplification means
without holding any signal charges in said capacitance
means in correspondence with each of capacitance values
obtained by adding said different additive capacitance
5 unit to each of said capacitance unit and said additive
capacitance unit, and holding read-out modes in which a
signal is read out from said amplification means while
keeping the signal charges held by said capacitance
means in correspondence with each of capacitance values
10 obtained by adding said different additive capacitance
unit to each of said capacitance unit and said additive
capacitance unit are prepared in number corresponding
to the number of different additive capacitance units.

15 10. A solid-state image pickup apparatus
comprising:

a photoelectric conversion unit;
capacitance means for holding signal charges
transferred from said photoelectric conversion unit;
20 a transfer field effect transistor for
transferring the signal charges from said photoelectric
conversion unit and adding a capacitance formed by a
channel to said capacitance means to increase a
capacitance value; and

25 amplification means for outputting a first signal
without holding any signal charges in said capacitance
means and outputting a second signal corresponding to

the signal charges held by said capacitance means or
the signal charges held by said capacitance means and
the capacitance of said transfer field effect
transistor,

5 wherein a first signal read-out from said
amplification means has a non-holding read-out mode in
which a signal is read out from said capacitance means
without holding any signal charges, and

10 a second signal read-out from said amplification
means has a first holding read-out mode in which a
signal is read out while keeping the signal charges
held by said capacitance means and the capacitance of
said transfer field effect transistor, and a second
15 holding read-out mode in which a signal is read out
while keeping the signal charges held by said
capacitance means.

11. A solid-state image pickup apparatus
comprising:

20 a photoelectric conversion unit;
 first and second transfer means for transferring
signal charges from said photoelectric conversion unit;
 first capacitance means, inserted between said
first transfer means and said second transfer means,
25 for holding the transferred signal charges;
 second capacitance means, arranged on an output
side of said second transfer means, for holding the

transferred signal charges; and

amplification means for outputting a first signal
without holding any signal charges in said first and
second capacitance means or said second capacitance
5 means and outputting a second signal corresponding to
the signal charges held by said first and second
capacitance means or said second capacitance means,

wherein a first signal read-out from said
amplification means has a first non-holding read-out
10 mode in which a signal is read out from said first and
second capacitance means without holding any signal
charges, and a second non-holding read-out mode in
which a signal is read out from said second capacitance
means without holding any signal charges, and

15 a second signal read-out from said amplification
means has a first holding read-out mode in which a
signal is read out while keeping the signal charges
held by said first and second capacitance means, and a
second holding read-out mode in which a signal is read
20 out while keeping the signal charges held by said
second capacitance means.

12. An apparatus according to claim 8, further
comprising first addition means for adding output
25 signals in the respective non-holding read-out modes,
second addition means for adding output signals in the
respective holding read-out modes, and subtraction

means for subtracting an output from said first addition means from an output from said second addition means.

5 13. An apparatus according to claim 10, further comprising first addition means for adding output signals in the respective non-holding read-out modes, second addition means for adding output signals in the respective holding read-out modes, and subtraction
10 means for subtracting an output from said first addition means from an output from said second addition means.

 14. An apparatus according to claim 11, further
15 comprising first addition means for adding output signals in the respective non-holding read-out modes, second addition means for adding output signals in the respective holding read-out modes, and subtraction means for subtracting an output from said first
20 addition means from an output from said second addition means.

 15. An apparatus according to claim 8, further comprising subtraction means for subtracting an output
25 signal in the read-out mode from an output signal in the holding read-out mode when the capacitance values are equal or substantially equal in correspondence with

the number of capacitance values varying.

16. An apparatus according to claim 10, further comprising subtraction means for subtracting an output
5 signal in the read-out mode from an output signal in the holding read-out mode when the capacitance values are equal or substantially equal in correspondence with the number of capacitance values varying.

10 17. An apparatus according to claim 11, further comprising subtraction means for subtracting an output signal in the read-out mode from an output signal in the holding read-out mode when the capacitance values are equal or substantially equal in correspondence with
15 the number of capacitance values varying.

18. An apparatus according to claim 1, wherein said additive capacitance unit or said additive
20 capacitance unit and said different additive capacitance unit comprise variable capacitive elements electrically connected in parallel to said capacitance unit.

19. An apparatus according to claim 8, wherein
25 said additive capacitance unit or said additive capacitance unit and said different additive capacitance unit comprise variable capacitive elements

electrically connected in parallel to said capacitance unit.

20. An apparatus according to claim 8, wherein the
5 order of the first non-holding read-out mode and the second non-holding read-out mode is the same as that of the first holding read-out mode and the second holding read-out mode.

10 21. An apparatus according to claim 11, wherein the order of the first non-holding read-out mode and the second non-holding read-out mode is the same as that of the first holding read-out mode and the second holding read-out mode.

15 22. A solid-state image pickup apparatus using, as an area sensor, said solid-state image pickup apparatus of any one of claims 1 to 21.

20 23. A solid-state image pickup apparatus using, as a line sensor, said solid-state image pickup apparatus of any one of claims 1 to 21.

25 24. A signal read-out method for a solid-state image pickup apparatus which holds, in capacitance means, signal charges generated by a photoelectric conversion unit and outputs a signal corresponding to

the signal charges held by said capacitance means from amplification means, comprising

a first read-out mode in which a signal is output from said amplification means while holding the signal charges generated by said photoelectric conversion unit in said capacitance means set at a first capacitance value, and

a second read-out mode in which, after the first read-out mode, the capacitance value of said capacitance means is changed from the first capacitance value to a second capacitance value, and a signal corresponding to the signal charges held by said capacitance means set at the second capacitance value is output from said capacitance means.

25. A method according to claim 24, further comprising at least one read-out mode in which, after the second read-out mode, the capacitance value of said capacitance means is changed from the second capacitance value to an arbitrary capacitance value, and a signal corresponding to the signal charges held by said capacitance means set at the arbitrary capacitance value is output from said amplification means.

26. A signal read-out method for a solid-state image pickup apparatus, comprising:

a holding read-out mode in which a signal corresponding to signal charges generated by a photoelectric conversion unit is output from amplification means while keeping the signal charges held by capacitance means; and

a non-holding read-out mode in which a signal is output from said amplification means without holding any signal charges in said capacitance means,

wherein the holding read-out mode has a first holding read-out mode in which a signal is output from said amplification means while keeping the signal charges held by said capacitance means set at a first capacitance value, and a second holding read-out mode in which a signal is output from said amplification means while keeping the signal charges held by said capacitance means whose capacitance value is set at a second capacitance value different from the first capacitance value, and

the non-holding read-out mode has a first non-holding read-out mode in which a signal is output from said amplification means without holding any signal charges in said capacitance means set at the first capacitance value, and a second non-holding read-out mode in which a signal is output from said amplification means without holding any signal charges in said capacitance means whose capacitance value is set at the second capacitance value different from the

first capacitance value.

27. A method according to claim 26, further comprising:

5 at least one holding read-out mode in which the capacitance value of said capacitance means is changed from the second capacitance value to an arbitrary capacitance value, and a signal is output from said amplification means while keeping the signal charges
10 held by said capacitance means set at the arbitrary capacitance value; and

at least one non-holding read-out mode in which the capacitance value of said capacitance means is changed from the second capacitance value to an
15 arbitrary capacitance value, and a signal is output from said amplification means without holding any signal charges in said capacitance means set at the arbitrary capacitance value.

20 28. A signal read-out method for a solid-state image pickup apparatus, comprising:

a holding read-out mode in which a signal corresponding to signal charges generated by a photoelectric conversion unit is output from
25 amplification means while keeping the signal charges held by capacitance means; and

a non-holding read-out mode in which a signal is

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output from said amplification means without holding
any signal charges in said capacitance means,

wherein the holding read-out mode has a first
holding read-out mode in which a signal is output from
5 said amplification means while keeping the signal
charges held by said capacitance means set at a first
capacitance value, and a second holding read-out mode
in which a signal is output from said amplification
means while keeping the signal charges held by said
10 capacitance means whose capacitance value is set at a
second capacitance value different from the first
capacitance value, and

the non-holding read-out mode has a non-holding
read-out mode in which a signal is output from said
15 amplification means without holding any signal charges
in said capacitance means set at the second capacitance
value.

29. A solid-state image pickup apparatus including
20 a plurality of pixels, each pixel comprising:

a photoelectric conversion unit;
holding means for holding a signal from said
photoelectric conversion unit;
read-out means for reading out the signal held by
25 said holding means; and
capacitance changing means for changing a
capacitance value of said holding means.

30. An apparatus according to claim 29, further comprising control means having a first mode in which a signal is read out from said read-out means while keeping said holding means set at a first capacitance value by said capacitance changing means, and a second mode in which a signal is read out from said read-out means while keeping said holding means set at a second capacitance value by said capacitance changing means.

31. An apparatus according to claim 30, further comprising addition means for adding the signal read out in the first mode and the signal read out in the second mode.

32. A solid-state image pickup apparatus comprising:

a photoelectric conversion unit; and
a charge/voltage conversion unit for converting signal charges transferred from said photoelectric conversion unit into a signal voltage,
wherein said charge/voltage conversion unit comprises a plurality of capacitances having different dependences on voltage.

33. An apparatus according to claim 32, wherein said charge/voltage conversion unit comprises an impurity diffusion region and a MOS structure unit, and

the plurality of capacitances having different dependences on voltage comprise a capacitance formed in the impurity diffusion region and a capacitance formed in said MOS structure unit.

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34. An apparatus according to claim 32, wherein said charge/voltage conversion unit comprises an impurity diffusion region and a buried semiconductor junction portion, and the plurality of capacitances having different dependences on voltage comprise a capacitance formed in the impurity diffusion region and a capacitance formed in said buried semiconductor junction portion.

35. An apparatus according to claim 34, wherein the dependence of the capacitance formed in said buried semiconductor junction portion on voltage is controlled by an impurity concentration or depth of a semiconductor region of one conductivity type of said semiconductor junction portion.

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36. An apparatus according to claim 35, wherein the dependence of the capacitance formed in said buried semiconductor junction portion on voltage is controlled by a width of a semiconductor region of one conductivity type of said semiconductor junction portion.

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37. An apparatus according to claim 32, further comprising reset means for applying a reset voltage to reset said charge/voltage conversion unit, wherein a charge/voltage conversion efficiency of said
5 charge/voltage conversion unit is controlled by controlling a voltage value of the reset voltage.

38. An apparatus according to claim 37, further comprising sampling means for sampling a light amount
10 incident on said photoelectric conversion unit, wherein the reset voltage is set in accordance with a sampling signal from said sampling means.

39. An apparatus according to claim 38, wherein
15 the sampling signal is a signal one frame ahead.

40. An apparatus according to claim 38, wherein the sampling signal is one of an overflow drain signal and a smear signal.
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41. An apparatus according to claim 38, wherein before an accumulation period of the signal charges, second signal charges accumulated in an accumulation period shorter than the accumulation period are
25 transferred to the impurity diffusion region, and the second signal charges are used as the sampling signal.

a photoelectric conversion unit;

control means for controlling to change a charge/voltage conversion efficiency of said charge/voltage conversion unit in accordance with the charge amount of the signal charges; and

15 43. An apparatus according to claim 42, wherein
said control means comprises reset means for applying a
reset voltage to reset said charge/voltage conversion
unit, and the charge/voltage conversion efficiency of
said charge/voltage conversion unit is controlled by
20 controlling a voltage value of the reset voltage.

a photoelectric conversion unit;

25 a charge/voltage conversion unit for generating a
voltage corresponding to a charge amount of the signal
charges from said photoelectric conversion unit; and

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wherein a charge/voltage conversion efficiency of
5 said charge/voltage conversion unit changes in
accordance with the charge amount of the signal
charges.